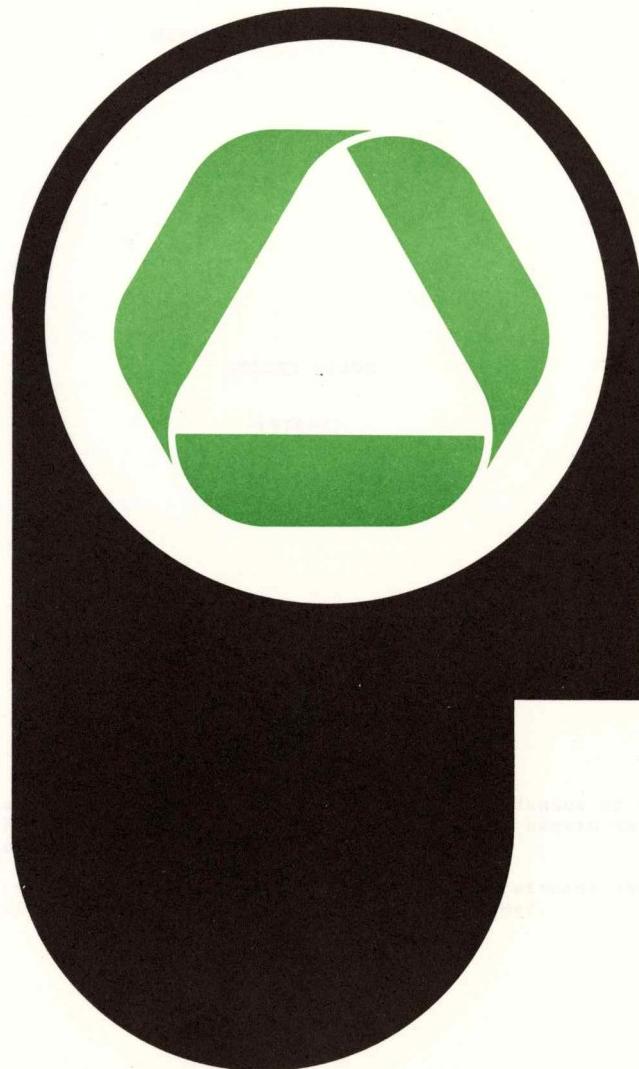


# Science



Sir George Williams  
Faculty of Science

## Mathematics and Statistics





SIR GEORGE WILLIAMS CAMPUS

DEPARTMENT OF MATHEMATICS

COURSE GUIDE

1976-77

This course guide has been prepared months in advance of the 1976-77 academic year and information contained herein is subject to change.

Students are advised not to purchase any texts without the approval of the department or professor concerned.



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STUDY ROOMS

TELEGRAMS

#### FULL-TIME FACULTY

Professor of Mathematics and  
Chairman of Department

Maurice Cohen, Ph.D. (Berkeley)

Associate Professor and Assistant Dean

Leonda S. Adler, M.A. (McGill)

#### Professors

Frederick W. Bedford, M.Sc. (McGill)  
Victor Byers, Ph.D. (McGill)  
Martin Harrow, Ph.D. (McGill)  
Norman E. Smith, Ph.D. (McGill)

#### Adjunct Professors

B. MacGibbon Taylor, Ph.D. (McGill)  
A. S. Rao, Ph.D. (Calgary)

#### Visiting Professor

D. H. Wheeler, B.Sc. (King's College, London)

#### Associate Professors

Kailash K. Anand, M.A. (Delhi)  
Mary A. Brian, M.A. (Bryn Mawr)  
Josef Brody, R.N.D. (Charles)  
W. P. Byers, Ph.D. (Berkeley)  
G. E. Cohen, Ph.D. (McGill)  
T. Dwivedi, Ph.D. (Clarkson)  
R. L. Hall, Ph. D. (London)  
N. Herscovics, M.Sc. (McGill)  
Joel Hillel, Ph.D. (U.B.C.)  
G. S. Lingappaiah, M.Sc. (Mysore)  
M. A. Malik, Ph.D. (Montreal)  
Eugen A. Pollitzer, M.Sc. (Rutgers)  
Harold W. Proppe, Ph.D. (McGill)  
R. Raphael, Ph.D. (McGill)  
John Senez, M.Sc. (McGill)  
Manfred E. Szabo, Ph.D. (McGill)  
J. C. Turgeon, Ph.D. (Columbia)  
M. Zaki, Ph.D. (Montreal)

#### Assistant Professors

J. Aleong, Ph.D. (Iowa State)  
Morton M. Belinsky, M.Sc. (McGill)  
A. Boyarsky, Ph.D. (McGill)  
A. G. Buckley, Ph.D. (U.B.C.)  
J. Fiksel, Ph.D. (Stanford)

M. Kervin, Ph.D. (Oregon)  
Z. Khalil, Ph.D. (Moscow)  
Y. H. Wang, Ph.D. (Ohio State)

### Sessional Lecturer

M. Alberta Boswall, B.Sc. (Dalhousie)

The department of mathematics offers a wide range of programmes in mathematics, applied mathematics and statistics.

The programmes in mathematics provide the fundamental concepts of algebra and analysis for the students who are interested in mathematics for its own sake and at the same time give the necessary background to those who will later decide to apply their knowledge.

Applied mathematics deals with real world problems which are translated into mathematical ones whose solutions are then interpreted in terms of the original problems.

Statistics deals with the collection and analysis of data. It is based on probability theory and is widely applied in the modern world.

Opportunities for further study as well as careers in teaching, research, industry, business and government are open to graduates of the programmes.

All programmes are available to part-time as well as full-time students. Moreover, modular scheduling in Mathematics programmes allows students to complete a degree, while employed, in a shorter time span than would be possible through ordinary part-time studies.

Minor programmes may be taken to complement other fields of study.

## PROGRAMMES

- \* Starred courses are three (3) credits; all others are six (6) credits.

Mathematics N-241, N-261, N-270, N-281, N-290, N-291 and N-292 may be taken by anyone with CEGEP Mathematics 103, 105 and 203.

## Minors

## Mathematics

N261, N281 and 12 additional credits approved by the department from among:

N241, N270, N292, N311\*, N366\*, N372\*, N373\*

Note 1. Substitutions in the electives to meet students' special requirements may be made by the department.

2. It is recommended that students choose their electives in accordance with their main interest, viz,  
 Teaching: N292, N366\*, N372\*  
 Social sciences: N241, N270  
 Natural sciences: N270, N311\*, N366\*

#### Statistics

N241, N341\*, N343\* and 12 additional credits approved by the department from among:  
 N261, N281, N342\*, N351\*

#### Liberal Arts Minor in Mathematics

24 credits in Mathematics approved by the department.

#### Majors

##### Mathematics

N241, N261, N281, N292, N361, N366\*, N372\* and 6 additional credits approved by the department from among:  
 N311\*, N322\*, N373\*, N381\*, N391\*

##### Applied Mathematics

N241, N261, N270, N281, N290\*, N311\* and 12 additional credits approved by the department from among:  
 N291\*, N312\*, N331, N351\*, N366\*, courses in related fields.

#### Statistics

N241, N261, N281, N290\*, N341\*, N343\*, N351\*, N352\*, N372\* and 6 additional credits approved by the department from among:  
 N312\*, N342\*, N353\*, N441\*, N442\*, N451\*, , N452\*

#### Specialization

##### Mathematics

N241, N261, N281, N292, N361, N366\*, N372\*, N373\*, N381\*, N391\*, N466\*, N491\* and 9 additional credits in Mathematics or related fields approved by the department.

##### Applied Mathematics

N241, N261, N281, N311\*, N351\*, N361 and 6 credits from among N270, N372\*, N373\* and 18 additional credits approved by the department from among N312\*, N331, N341\*, N353\*, N354\*, N366\*, N381\*, N431, N432\*, N433\*, N434\*, N442\*, N471\*, N472\*, N473\*

**Note:** It is recommended that students choose their electives in accordance with their interests, e.g.

Operations research: N312\*, N331, N431, and one of:  
 N432\*, N433\*, N434\*

Control theory: N353\*, N366\*, N433\*, N434\*, N472\*, N473\*

Industrial applications: N312\*, N331, N341\*, N353\*, N442\*.

#### Statistics

N241, N261, N281, N290\*, N312\*, N341\*, N343\*, N351\*, N352\*, N372\*, N441\* and 18 additional credits approved by the department from among: N291\*, N331, N342\*, N353\*, N354\*, N361, N431, N442\*, N451\*, N452\*

#### Honours

##### Mathematics

First year: N241, N261, N281, N292

Second year: N361, N366\*, N372\*, N373\*, N381\*, N391\*

Third year: N461, N466\*, N491\* and one of N467\*, N492\*

Twelve (12) credits in second and third years chosen from among: N311\*, N312\*, N321\*, N322\*, N331, N351\*, N392\*, N431, N432\*, N433\*, N451\*, N471\*, N475\*, N499\*; courses in related fields with prior Departmental approval.

### Applied Mathematics

First year: N241, N261, N281, N292

Second year: N311\*, N351\*, N361, N372\*, N373\*

Option A: N331

Option B: N312\*, N366\*

Third year: N433\*, N434\*

Option A: N312\*, N431, N432\* and 6 additional credits approved by the Department of Mathematics

Option B: N353\*, N472\*, N473\*, N474\*, N461.

Note Students interested in Operations Research will take

Option A, while those interested in Control Theory will opt for Option B.

### Statistics

First year: N241, N261, N281, N292

Second year: N351\*, N352\*, N361, N366\*, N372\*, N381\*

Third year: N451\*, N452\*, N461

Fifteen credits in mathematics or related fields approved by the department.

Information about any course may be obtained from the Course Examiner or the Department.

The actual times at which a course is offered may be found in the time-table. (Some courses are also offered in the Summer.)

### Mathematics N-200 (3 credits)

#### Fundamental Concepts of Algebra

Course Examiner: J. Turgeon

Given in the Day & Evening first term.

Given in the Evening second term.

#### Course Description:

This is a course designed for mature students who need a modern background for Mathematics N-201. Sets, axiomatics, algebraic techniques, inequalities, analytic geometry of lines, circles, parabolas.

Text: Swokowski: "Fundamentals of Algebra and Trigonometry", 3rd ed.

Note: Students who have credit for Mathematics N-201 or equivalent may not take this course for credits.

#### Assignments and Grading:

Assignments are given every week and graded by a marker. There are two one-hour class texts, and a three-hour final examination. Final grade is based on higher of (a) the final or, (b) a weighted average of the class tests (40%) and the final (60%).

### Mathematics N-201 (3 credits)

#### Elementary Functions

Course Examiner: J. Turgeon

Given in the Day & Evening both terms.

#### Course Description:

Sets. Field of real numbers. Inequalities. Functions and graphs. Trigonometric, exponential, and logarithmic functions.

#### Special Comments:

Note: Any student who has passed (a) Mathematics 001 or the equivalent or (b) Mathematics 223 or the equivalent may not take this course for credits.

**Mathematics N-202 (3 credits)**

**College Algebra**

**Course Examiner:** F. Bedford

**Given in the Day & Evening both terms.**

**Course Description:**

Proofs and implications. The natural numbers and the integers. Mathematical induction. Divisibility, the Euclidean Algorithm, primes, the Fundamental Theorem of Arithmetic. Sequences and progressions. Complex numbers, polynomials, the Fundamental Theorem of Algebra. Combinatorial Mathematics, the Binomial Theorem. Systems of equations determinants, Cramers' Rule.

**Text:** "College Algebra" S.G.W. Department of Mathematics

**Assignments and Grading:**

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination, (b) the weighted average of the final examination (60%) and the class tests (40%).

**Prerequisite Courses:**

Mathematics N-201 or equivalent, previously or concurrently.

**Special Comments:**

**Note:** Any student who has passed (a) CEGEP Mathematics 101 or the equivalent or (b) Mathematics 213 or the equivalent may not take this course for credits.

(a) unless and otherwise the student has completed (b) to mathematics up to 100 hours and has been introduced to the material about and beyond the material contained in the course.

The actual value of each course is determined by the student's ability to understand the material presented in the course.)

**Mathematics N-203 (3 credits)**

**Differential and Integral Calculus**

**Given in the Day & Evening both terms.**

**Course Examiner:** J. Brody

**Course Description:**

Functional notation. Differentiation of polynomials. The power product, quotient and chain rules. Differentiation of the elementary functions. Implicit differentiation. Higher derivatives. Maxima and Minima. Applications; tangents to plane curves, related rates. Approximations using the differential. Antiderivatives, definite integral, area.

**Text:** Bonic "Freshman Calculus"

**Assignments and Grading:**

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination, (b) the weighted average of the final examination (60%) and the class tests (40%).

**Prerequisite Courses:**

Mathematics N-201 or equivalent.

**Special Comments:**

**Note:** Any student who has passed (a) CEGEP Mathematics 103 or the equivalent or (b) Mathematics 451 or the equivalent may not take this course for credits.

**Mathematics N-204 (3 credits)**

**Vector Analysis and Analytical Geometry**

**Given in the Day & Evening both terms.**

**Course Examiner:** M.A. Brian

Course Description:

Inner and cross products of vectors. Algebraic and vector equations of curves in the plane and in space. Elementary study of surfaces in space. Curves and surfaces in parametric form. Polar, spherical, and cylindrical coordinates.

Text: Spitzbart "Analytic Geometry"

Assignments and Grading:

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination (b) the weighted average of the final examination (60%) and the class tests (40%).

Prerequisite Courses: Mathematics N-201 or equivalent.

Special Comments:

Note: Any student who has passed (a) CEGEP Mathematics 105 or the equivalent or (b) Mathematics 431 or the equivalent may not take this course for credits.

Mathematics N-205 (3 credits)

Differential and Integral Calculus II Given in the Day & Evening both terms.

Course Examiner: F. Bedford

Course Description:

Integration of trigonometric and exponential functions. Techniques of integration: substitutions, integration by parts, partial fractions. Improper integrals. Physical applications of the definite integral. Infinite series: tests for convergence. Power series, Taylor's theorem.

Text: Bonic "Freshman Calculus"

Assignments and Grading:

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination (b) the weighted average of the final examination (60%) and the class tests (40%).

Prerequisite Courses: Mathematics N-203

Special Comments:

Note: Any student who passes (a) CEGEP Mathematics 203 or the equivalent or (b) Mathematics 451 or the equivalent may not take this course for credits.

Mathematics N-206 (3 Credits)

Linear Algebra for the Social Sciences

Course Examiner: M.A. Boswall

Given in the Day,  
first term.

Given in the Evening,  
second term.

Course Description:

Operations on Matrices. Determinants, Cramers' Rule. Systems, rank. The inverse matrix. The Gauss Jordan Method, Mappings, matrix transformation, Linear Transformations, Characteristic Values, vectors, quadratic forms.

Text: Campbell: "Matrices with Applications".

Assignments and Grading:

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination (b) the weighted average of the final examination (60%) and the class tests (40%).

Prerequisite Courses: Mathematics N-202

Special Comments:

Note: Any student who has passed (a) Mathematics 006 or the equivalent or (b) Mathematics 411 or N-281 or the equivalent may not take this course for credits.

**Mathematics N-207 (3 credits)**

Statistics for the Social Sciences Given in the Day & Evening first term.

Course Examiner: Z. Khalil

Given in the Day, second term.

Course Description:

Elementary probability, permutations and combinations, binomial and normal distribution. Analysis and organization of statistical data. Tests of hypotheses. Confidence limits. Introduction into linear regression and correlation.

Text: Mendenhall "Introduction to Probability and Statistics" 4th ed.

Assignments and Grading:

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination (b) the weighted average of the final examination (60%) and the class tests (40%).

Prerequisite Courses: Mathematics N-201 or equivalent, or permission of Department of Mathematics or of Economics.

Special Comments:

Note: Any student who has passed (a) Mathematics 007 or the equivalent or (b) Mathematics N-241 or the equivalent may not take this course for credits.

**Mathematics N-208 (3 credits)**

Fundamental Mathematics I

Given in the Day & Evening first term.

Course Examiner: J. Hayes

Given in the Evening second term.

Course Description:

This course is intended primarily for pre-Commerce students. Progressions, compound interest, annuities; permutations, combinations and binomial theorem; systems of linear equations inequalities, linear programming; matrices.

Text: Bush and Young, "Foundations of Mathematics with Applications to the Social and Management Sciences" 2nd ed.

Assignments and Grading:

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination (b) the weighted average of the final examination (60%) and the class tests (40%).

Prerequisite Courses: Mathematics N-201 or equivalent.

Special Comments:

Note: Students with credits for Mathematics N-202 or equivalent may not take this course for credits.

**Mathematics N-209 (3 credits)**

Fundamental Mathematics II

Given in the Evening, first term.

Course Examiner: J. Hayes

Given in the Day & Evening second term.

Course Description:

This course is intended primarily for pre-Commerce students. Limits, differentiation of rational, exponential and logarithmic functions, theory of maxima and minima, integration.

Text: Bowen: "Mathematics with Applications in Management and Economics" 3rd ed.

Assignments and Grading:

Assignments are given weekly and graded by a marker. There are two one-hour class tests and a three-hour final examination. The final grade is based on the higher of (a) the final examination (b) the weighted average of the final examination (60%) and the class tests (40%).

Prerequisite Courses: Mathematics N201 or equivalent.

Special Comments:

Note: Students with credits for N-203 or equivalent may not take this course for credits.

Mathematics N-210 (3 credits)

Mathematics for the Biological Sciences

Course Examiner: R. Hall

Course Description:

Day Time

Set theory, combinatorics, probability, matrices, differential and difference equations; applications to the biological sciences.

Text: Grossman & Turner, "Mathematics for the Biological Sciences"

Prerequisite Courses: CEGEP Mathematics 103 or equivalent.

Mathematics N-241 (440) (6 credits)

Day Time

Introductory Mathematical and Applied Statistics TT 10:15-11:30  
MWF 10:55-11:45

Course Examiner: Y. Wang

Course Description:

Course Description:

The introductory mathematical theory of statistics including: the experimental approach to statistics, probability, distributions, moments and sampling theory, problems in estimation, hypothesis testing, correlation and regression.

Text: Freund: "Mathematical Statistics" 2nd ed.

Prerequisite Courses: CEGEP Mathematics 203 or equivalent.

Mathematics N-261 (6 credits)

Day Time

Advanced Calculus

Course Examiner: M. Malik

TT 13:15-14:30  
Wed 18:15-20:10

2nd Term MWF 12:00-12:55  
and TT. 11:45- 1:00

Course Description:

Methods of integration. Vector functions of a single variable, curves. Scalar functions of several variables, limits, continuity, partial derivatives, total differential. Vector functions of several variables, divergence, curl. Maxima and minima. Multiple integrals, change of variables. Line integrals, Green's theorem. Surface integrals, divergence theorem, Stokes's theorem. Applications.

Text: Protter and Morrey: "Calculus with Analytic Geometry: A Second Course".

Prerequisite Courses: CEGEP Mathematics 105, 203.

Mathematics N-270(452) (6 credits)

Day Time

Differential Equations for the Natural Sciences

MWF 9:50-10:40  
Wed 20:30-22:25

Course Examiner: A. Boyarsky

Course Description:

First order first degree equations, linear equations, operators. Laplace transforms, series solutions and special functions,

numerical methods, elementary partial equations, Fourier series.

Text: Boyce & di Prima: "Elementary differential Equations and Boundary Value Problems". (2nd ed)

Prerequisite Courses: CEGEP Mathematics 203 or equivalent.

Special Comments:

Note: Only 6 credits will be given for both N-270 and N-372. Students credited with N-372 and N-373 may not take this course for credits.

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**Mathematics N-281 (6 credits)**

**Linear Algebra I**

Course Examiner: W. Byers

Day Time

Mon 20:30-22:25  
MWF 13:05-13:55

2nd Term and  
TT 1:15- 2:30

Course Description:

Vectors in  $R^n$ , matrices, linear equations, vector spaces, linear transformations, determinants, equivalence relations on matrices, characteristic values and vectors, diagonalization, metric concepts.

Text: Bradley, "A Primer of Linear Algebra"

Prerequisite Courses: CEGEP Mathematics 101, 105, or equivalent.

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**Mathematics N-290 (3 credits)**

**Algebraic Systems (Introduction)**

Course Examiner: J. Hillel

Day Time  
Wed 20:30-22:25  
TT 08:45-10:00

(first term)

Course Description:

Sets, functions, binary operations, examples of number systems, polynomial functions, divisibility, definitions and examples of groups and subgroups, fields.

Text: Moore: "Introduction to Abstract Algebra"

Prerequisites: Collegial pre-science mathematics profile or equivalent.

Note: Students credited with Math N-202 may not take this course for credits.

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**Mathematics N-291 (3 credits)**

**Algebraic Systems (Continuation)**

Day Time  
Wed 20:30-22:25  
TT 8:45-10:00  
(second term)

Course Examiner: J. Hillel

Course Description:

Groups, rings, homomorphisms, integral domains, fields, polynomial rings.

Text: Moore, "Introduction to Abstract Algebra"

Prerequisite Courses: Permission of the Department.

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**Mathematics N-292 (6 credits)**

**Algebraic Systems I**

Day Time  
TT 08:45-10:00  
Wed 20:30-22:25

Course Examiner: J. Hillel

Course Description:

Sets, functions, binary operations, examples of number systems, polynomial functions, divisibility, groups, rings, homomorphisms, integral domains, fields, polynomial rings.

Text: Moore, "Introduction to Abstract Algebra"

Prerequisites: Collegial pre-science mathematics profile or equivalent.

Note: Only 6 credits will be given for both Mathematics N-202 and N-292.

**Mathematics N-311 (3 credits)**

Day Time

TT 13:15-14:30

(second term)

Wed 18:15-20:10

(first term)

**Course Examiner:** A. Buckley

**Course Description:**

Introduction to computers and Fortran, solutions of equations, curve fitting, numerical differentiation and integration, matrix computation, errors. Lectures and laboratory.

**Text:** Conte and de Boor, "Elementary Numerical Analysis" 2nd ed.

**Prerequisite Courses:** Mathematics N-261 or equivalent.

**Mathematics N-312 (3 credits)**

Day Time

Numerical Linear Algebra

TT 13:15-14:30

(first term)

Wed 18:15-20:10

(second term)

**Course Examiner:** A. Buckley

**Course Description:**

Linear systems, matrix inversion, relaxation methods, method of least squares, G-inverses, canonical forms, determination of characteristic values, applications.

**Text:** Stewart, "Introduction to Matrix Computation"

**Prerequisite Courses:** Mathematics N-281 or equivalent.

**Mathematics N-321 (3 credits)**

Set Theory

Not given in  
1976/77.

**Course Examiner:** M. Szabo

**Course Description:**

Intuitive logic, axiomatic set theory, ordinals, axiom of choice, cardinals.

**Text:** Monk: "Introduction to Set Theory".

**Prerequisite Courses:** 18 credits in post-collegial Mathematics.

**Mathematics N-322 (3 credits)**

Day Time

Mathematical Logic.

Tue 17:45-20:10

**Course Examiner:** M. Szabo

**Course Description:**

First-order theories, models, incompleteness, selected topics.

**Text:** Eisenberg, "Axiomatic Theory of Sets and Classes"

**Prerequisite Courses:** 18 credits in post-collegial Mathematics.

**Mathematics N-331 (6 credits)**

Day Time

Deterministic Methods of Operations Research

MWF 1:05- 1:55

Thu 18:15-20:10

**Course Examiner:** J. Senez

**Course Description:**

Formulation of mathematical models in the deterministic case, methods of solution, testing the models. Applications to allocation(linear programming), competition (game theory), scheduling, networks and flow. Emphasis on mathematical methods, including matrix algebra and search techniques.

**Text:** Cooper & Steinberg, "Methods and Applications of Linear Programming"

**Prerequisite Courses:** Mathematics N-281 or equivalent.

Introduces to deterministic optimization, simple distributions, value and several estimators, test of hypotheses (parametric and non-parametric) regression analysis.

Mathematics N-341 (3 credits) Day Time  
 Experimental Statistics TT 10:15-11:30  
 (First Term)

Course Examiner: E. Pollitzer

Course Description:

Experimental models. Regression and correlation, analysis of variance. Experimental designs. Randomized blocks, Latin squares, factorial confoundings.

Text: Dunn & Clark, "Applied Statistics"

Prerequisite Courses: Mathematics N-241 or equivalent.

Mathematics N-342 (3 credits) Day Time  
 Industrial Statistics Tue 20:30-22:25  
 (first term)

Course Examiner: P. Pollitzer

Course Description:

Concepts of statistical control, X, R, P and C charts. Acceptance sampling, sequential probability ratio tests, sampling inspection, continuous sampling plans, reliability and life tests.

Text: Duncan "Industrial Statistics and Quality Control".

Prerequisite Courses: Mathematics N-241 or equivalent.

Mathematics N-343 (3 credits) Day Time  
 Data Analysis and Survey Sampling TT 10:15-11:30  
 (second term)

Course Examiner: E. Pollitzer

Course Description:

Basic concepts of sampling. Simple, stratified, systematic, cluster sampling. Optimum allocation, ratio estimates. Curve fitting, goodness-of-fit tests, non-parametric tests, correlation and regression (bivariate and multivariate). Course time equally divided between theory and practical work.

Texts: Mendenhall, Ott, Scheaffer "Elementary Survey Sampling".  
 Mosteller & Rourke, "Sturdy Statistics"

Prerequisite Courses: Math N-241 or equivalent.

Mathematics N-351 (3 credits) Day Time  
 Discrete Probability and Markov Chains 1st MWF 8:45- 9:35  
 Term Tue 18:15-20:10

Course Examiner: Y. Wang

Course Description:

Axiomatic approach to probability theory, Bayes's rule, occupancy, runs and matching problems. Discrete random variables and their distributions. Generating functions, Introduction to Markov chains and queues.

Text: Chung, "Elementary Probability Theory with Stochastic Processes"

Prerequisite Courses: Mathematics N-241

Mathematics N-352 (3 credits) Day Time  
 Mathematical Statistics TT 08:45-10:00  
 (first term)

Course Examiner: Y. Wang

Course Description:

Introduction to multivariate distributions, sampling distributions, point and interval estimation, tests of hypotheses (parametric and non-parametric), regression models.

Text: Hogg and Craig "Introduction to Mathematical Statistics" 3rd ed.

Prerequisite Courses: Mathematics N-241, N-261.

**Mathematics N-353 (3 credits)**

Stochastic Processes and Applications. Not given in  
1976/77.

Course Examiner: M. Kanter

Course Description:

Continuous time stochastic processes. Poisson processes, continuous time Markov processes, queuing models, birth and death processes, renewal theory and reliability of systems.

**Mathematics N-354 (3 credits)**

Day Time

Information Theory.

Tue 20:10-22:25  
(second term)

Course Description:

Information and sources, Shannon's theorem for Markov sources. Probability relations in a channel, mutual information, error probabilities and decision rules.

Prerequisite Courses: Mathematics N-351 or equivalent or permission of Department.

**Mathematics N-361 (6 credits)**

Day Time

Real Analysis

MWF 9:50-10:40  
Thu 20:30-22:25

Course Examiner: M. Malik

Course Description:

Metric spaces, sequences and series, continuity, differentiation, Riemann integration, uniform convergence, equicontinuity, Weierstrass theorem. Differential forms, simplexes and chains, Stokes's theorem.

Text: Spivak, "Calculus"

Prerequisite Courses: Mathematics N-261, N-281

**Mathematics N-366 (3 credits)**

Complex Analysis I

Day Time

TT 08:45-10:00  
(second term)

Course Examiner: M. Zaki

Tue 20:30-22:25  
(first term)

Course Description:

Algebra and geometry of complex numbers, analytic functions. Cauchy-Riemann equations, the Cauchy integral formula, Taylor's and Laurent's theorems, calculus of residues.

Text: Levinson & Redheffer, "Complex Variables"

Prerequisite Courses: Mathematics N-261

**Mathematics N-372 (3 credits)**

Day Time

Wed 20:30-22:25  
MWF 12:00-12:50  
(First Term)

Course Examiner: J. Turgeon

Course Description:

First order differential equations, applications of first order differential equations. Second order linear equations, series solutions of second order linear equations, higher order linear equations, systems of equations. Difference equations.

Text: Boyce and Di Prima "Elementary Differential Equations and Boundary Value Problems" 2nd ed.

Prerequisite Courses: CEGEP Mathematics 105, 203; Mathematics N-281 previously or concurrently.

**Mathematics N-373 (3 credits)**

Day Time

MWF 12:00-12:50  
Wed 20:30-22:25

(2nd Term)

Course Examiner: W. Byers

Course Description:

Equations of hypergeometric type (Bessel and Legendre's equation). Laplace transform, inverse transform, applications to partial and integral equations. Fourier series. Boundary value problems and Sturm-Liouville theory.

Text: Boyce & Di Prima, "Elementary Differential Equations and Boundary Value Problems" 2nd ed  
Prerequisite Courses: Mathematics N-372, N-366.

Mathematics N-381 (3 credits)

Day Time

Linear Algebra II

TT 11:45-13:00  
(second term)

Course Examiner: E. Cohen

Course Description:

Matrices, linear transformations, determinants, metric concepts, inner product spaces, dual spaces, spectral theorem, bilinear and quadratic forms, canonical forms for linear transformations, matrix functions, selected topics.

Text: Moore "Elements of Linear Algebra and Matrix Theory".

Prerequisite Courses: Mathematics N-281, N-291.

Mathematics N-391 (3 credits)

Day Time

Algebraic Systems II

Mon 20:30-22:25  
TT 11:45-13:00  
(first term)

Course Examiner: J. Hillel

Course Description:

Groups: permutation groups, Cayley's theorem, cyclic groups, Lagrange's theorem, normal subgroups, quotient groups, isomorphism theorems. Rings: ideal and quotient rings, isomorphism theorems, characteristic. Fields: construction of quotient fields. Polynomials: polynomial rings, division algorithm, g.c.d., unique factorization, roots of a polynomial over a field. Selected topics.

Text: McCoy "Introduction to Modern Algebra" 3rd ed.

Prerequisite Courses: Mathematics N-291

Mathematics 392 (3 credits)

Elementary Number Theory

Day Time  
Tue 17:45-20:10  
(second term)

Course Examiner: N. Herscovics

Course Description:

Number systems, division and factorization, number theoretic functions, congruences, algebraic congruences and primitive roots, quadratic residues, diophantine equations.

Text: Niven & Zuckerman, "An Introduction to the Theory of Numbers"

Prerequisite Courses: 18 credits in post-collegial Mathematics.

Mathematics N-431 (6 credits)

Day Time

Probabilistic Methods of Operations Research

MWF 10:55-11:45

Course Examiner: J. Fiksel

Course Description:

Difference and differential-difference equations, z transforms, stochastic distributions. Markov chains, queuing theory, inventory theory, reliability and renewal theory, competition and introduction to decision theory, dynamic programming, simulation and Monte Carlo techniques; formulation, testing and stability of mathematical models incorporating uncertainty.

Text: Hillier - Lieberman, "Introduction to operations Research"

Prerequisite Courses: (a) Mathematics N-261; N-351 previously or concurrently; (b) Mathematics 440, 452.

Mathematics N-432 (3 credits)

Day Time

Theory of Graphs and Networks

MWF 13:05-13:55  
(second term)

Course Examiner: J. Fiksel

Course Description:

Directed and undirected graphs. Partitions, planar and non-planar graphs, matrix representation, applications, network theory.

Text: Busacker & Saaty "Finite Graphs and Networks".

Prerequisite Courses: Mathematics N-331

**Mathematics N-433 (3 credits)**

Calculus of Variations

Not given in  
1976/77.

Course Examiner: R. Hall

Course Description:

Nature of problems. Weak variations, the first variation, Euler's equation. The second variation, Jacobi's equation, Legendre's test, conjugate points. Relative maxima and minima, isoperimetrical problems. Integrals with variable end points. Applications to problems in pure and applied mathematics, the principle of least actions. Strong variations, the Weierstrass E-function.

Text: Smith, "Variational Methods of Optimization"

Prerequisite Courses: Mathematics N-371 or N-270.

**Mathematics N- 434 (3 credits)**

Day Time

Optimization Theory

Thu 20:30-22:25  
(second term)

Course Description:

A survey of optimization methods, search techniques, non-linear programming, dynamic programming. An introduction to optimal control and to the maximum principle.

Prerequisite Courses: Permission of Department.

**Mathematics N-441 (3 credits)**

Seminar in Applied Statistics

Not given in  
1976/77.

Course Examiner: T. Dwivedi

Course Description:

Formulation of some real-life problems where applications of statistical methods can be exploited. Analysis, interpretation of data, and inference of results. A report on a specific aspect of statistics may be required.

Prerequisite Courses: Permission of the Department.

**Mathematics N-442 ( credits)**

Introduction to Reliability

Course Examiner: Z. Khalil

Not given in  
1976/77.

Course Description:

Statistical failure models and reliability testing; system reliability; standby redundancy with and without repair; limit distributions.

Text:

Prerequisite course: Mathematics N-351

**Mathematics N-451 (3 credits)**

Day, Time  
Tue 18:15-20:30  
MWF 10:55-11:55  
(2nd Term)

Topics in Probability

Course Examiner: M. Kanter

Course Description:

Axioms for probability space. Random variables. Distribution functions, mathematical expectation. Law of large numbers. Limit theorems. Stochastic processes, Markov, Poisson, and Gaussian Processes.

Text: Giri, "Introduction to Probability & Statistics:

Part I Probability"

Prerequisite Courses: Mathematics N-261; N-351, or  
Permission of Department.

**Mathematics N-452 (3 credits)**

Day, Time

Linear Statistics

Course Examiner: G. Lingappaiah

MWF 08:45-10:00  
(second term)

Multivariate normal distribution, distribution of quadratic forms. Linear models. General linear hypothesis of full rank.

Text : Greybill, "Introduction to Linear Statistical Models, Vol.I"

Prerequisite Courses: Mathematics N-261, N-281, N-352

**Mathematics N-461 (6 credits)**

**Real Analysis II**

Day, Time

Thu 17:45-20:10

**Course Examiner:** M. Kervin

**Course Description:**

Measure spaces, Lebesgue measure, measurable functions, Lebesgue integration, Lebesgue-Stieltjes integration. Function spaces, Ascoli-Arzelà theorem, Stone-Weierstrass theorem, Hilbert spaces, Hahn-Banach theorem.

**Text:** Marsden, "Elementary Classical Analysis"

**Prerequisite Courses:** Mathematics N-361, N-391

**Mathematics N-466 (3 credits)**

Day, Time

**Complex Analysis II**

Tue 20:30-22:25

**Course Examiner:** M. Kervin

**Course Description:**

Analytic functions, power series, Cauchy's theorem, Morear's and Liouville's theorems, singularities, maximum modulus principle, Rouche's theorem. Conformal mappings, linear transformations, analytic continuation. Special functions.

**Text:** Levinson & Redheffer "Complex Analysis".

**Prerequisite Courses:** Mathematics N-366

**Mathematics N-467 (3 credits)**

Not given in  
1976/77

**Course Examiner:**

**Course Description:**

Normal families, Riemann mapping theorem, harmonic functions, elliptic functions, univalent functions, selected topics.

**Text:**

**Prerequisite Courses:** Mathematics N-466, Mathematics N-281, and Intermediate Algebra. A report on a specific aspect of analysis may be required.

**Prerequisite Courses:** Mathematics N-466, Mathematics N-281, and Intermediate Algebra. A report on a specific aspect of analysis may be required.

Day, Time

(subject to the arrangement

with examiner)

LECTURE

EXERCISES

**Mathematics N-471 (3 credits)**

Not given in  
1976/77.

**Partial Differential Equations**

**Course Examiner:** M. Cohen

**Course Description:**

Classification of partial differential equations, the Cauchy-Kowalewski theorem, characteristics, boundary value and eigen value problems for elliptic equations, initial value and intial boundary value problems for parabolic and hyperbolic equations.

**Prerequisite Courses:** Mathematics N-371

**Mathematics N-472 (3 credits)**

Linear Systems

Not given in  
1976/77.

**Course Examiner:**

**Course Description:**

State space analysis and design of continuous and discrete systems. Controllability and observability and model control, pole displacement techniques. Luenberger observers, Liapunov stability.

**Text:**

**Prerequisite Courses:** Mathematics N-281; Mathematics N-270 or N-372, N-373.

**Special Comments:**

**Note:** Students who have credit for Engineering N-571 may not take this course for credits.

**Text:** Linear Systems by Rugh, J. G. McGraw-Hill.

**Text:** Linear System Theory by Sontag, Academic.

**Text:** Linear System Theory by Kailath, Prentice-Hall.

**Mathematics N473 (3 credits)**

**Non-linear Systems**

Day Time

Thu 20:30-22:25  
(first term)

**Course Examiner:** A. Boyarsky

**Course Description:**

Examples of linear and non-linear systems, phase-plane analysis; periodic solutions and limit cycles; non-linear differential equations; perturbation methods; stability in the sense of Liapunov; linearization, Liapunov's direct method; Lagrange stability and boundedness of solutions, circle and Popov's criteria.

**Text:**

**Prerequisite Courses:** Mathematics N-281, N-270 or N-373.

**Special Comments:**

**Note:** Students who have credit for Engineering 614 may not take this course for credits.

**Mathematics N-474 (3 credits)**

**Introduction to Mathematical Control Theory**

Not given in  
1976/77.

**Course Examiner:**

**Course Description:**

Linear control systems. Attainable sets: compactness, convexity, continuity in time. Controllability and observability. Time optimal control. Maximum principle. Examples of physical systems. Switching curves. Optimal control with quadratic cost.

**Text:**

**Prerequisite Courses:** Mathematics N-361 and N-472.

**Mathematics N-475 (3 credits)**

**Geometry and Topology**

Not given in  
1976/77.

**Course Examiner:** M. Cohen

**Course Description:**

Topological spaces, separation axioms, compactness, connectedness. Introduction to combinatorial and algebraic topology; Euler characteristic; classification of surfaces; winding number of a curve, degree of a map, vector fields, applications; map colouring problems.

**Text:** Chinn and Steenrod "First Concepts of Topology"

**Prerequisite Courses:** Permission of Department.

**Mathematics N-491 (3 credits)**

Day Time

**Abstract Algebra I**

TT 11:45-13:00  
(first term)

**Course Examiner:** J. Hillel

**Course Description:**

Groups: composition series, direct product of groups, abelian groups, Sylow's theorems, solvable groups. Rings: Euclidean rings, unique factorization domains, principal ideal domains. Maximal, prime and primary ideals; ideals in noetherian rings, modules and vector spaces. Algebras. Selected topics.

**Text:** Herstein "Topics in Algebra"

**Prerequisite Courses:** Mathematics N-391

**Mathematics N-492 (3 credits)**

Day Time

**Abstract Alebra II**

Mon 17:45-20:10  
(second term)

**Course Examiner:** E. Cohen

**Course Description:**

Fields: prime fields; algebraic, finite, simple, separable, inseparable, normal extensions; finite fields; perfect and imperfect fields. Group characters. Galois theory; the fundamental theorem, solvability by radicals, transcendental extensions.

**Text:** Burton, "A First Course in Rings & Ideals"

**Prerequisite Courses:** Mathematics N-491

**Mathematics N-499 (3 credits)**

Day Time

Mathematical Thinking MWF 1:05- 1:55

Course Examiner: M. Cohen (First Term)

Course Description:

This course is intended to stimulate mathematical creativity and to improve the ability to think systematically, analyze problems, and communicate reasoning. Students participate actively in discussing and solving problems drawn from a variety of sources (including previous Putnam competitions) and are expected to explain their thinking both orally and in writing. Discussions include the following topics: problem posing; Polya's techniques of problem solving; equivalence and similarity of problems; generalization; applications. The problems are selected from: combinatorics geometry, group theory, number theory, real analysis. etc.

**Prerequisite Courses:** Permission of Department.